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ORIGINAL ARTICLE

Transmandibular approach in parapharyngeal tumors: When to do it?

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KEYWORDS

Mandibulotomy;
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Abstract *Background:* Multiple approaches to the parapharyngeal space are described in the literature, each having its indications, advantages, and disadvantages.
Objective: Highlighten the advantages of the transmandibular approach and state possible selection criteria for such approach in lesions affecting the parapharyngeal space.
Patients and methods: The transmandibular approach was used to excise the parapharyngeal space lesion in 11 consecutive patients. All the patients were clinically and radiologically evaluated before surgery. Fine needle aspiration cytology was done in two patients. Follow up period ranged from 1 to 8 years.
Results: The transmandibular approach allowed total removal of five big salivary tumors without capsular rupture, and safe excision of four carotid body tumors, a single vagal paraganglioma, and a single aneurysm of the internal carotid artery affecting the parapharyngeal space with easy distal

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control of the internal carotid artery. Preoperative angioembolization limited blood loss during surgery for the vascular lesions. Patients were followed up for 1–8 years with no evidence of recurrence. Complications included plate infection in a single patient (9%), a single mortality, and cranial neuropathies in three patients which were not related to the approach. Ugly facial scars, lip hypoesthesia, dental losses, malocclusion, and temporomandibular joint pain or dysfunction were not reported.

Conclusion: The transmandibular approach offers the widest access to the parapharyngeal space and allows safe complete excision of highly vascular and big swellings.

1. Introduction

Although tumors of the parapharyngeal space (PPS) are rare, they pose many challenging issues both in diagnosis and treatment. Assessment of such tumors is insufficient, due to the complex anatomical nature of the space making it inaccessible for clinical examination.[1] Lesions usually have late presentation, with few and similar symptoms despite their variable pathologic origin.[2] The advancement of imaging modalities, including multislice computerized tomogram (CT), and magnetic resonance imaging (MRI) allows proper localization and characterization of these tumors.[3] In addition, refinement of angioembolization reduces the blood loss and facilitates excision of the vascular tumors. Multiple surgical approaches have been described in the literature reflecting the difficulty to access the PPS. The commonest approaches used are the transcervical and the transparotid with the least used being the transmandibular one.[4,5] The aim of this study is to highlighten the advantages of the transmandibular approach and state possible selection criteria for such approach in certain lesions affecting the PPS.

2. Patients and methods

This study included 11 consecutive patients diagnosed to have parapharyngeal space occupying lesions that were subjected to surgical excision by the transmandibular approach in the departments of ENT and Vascular Surgery, Assiut University Hospital in the period from July 1999 till July 2009.

The following data were collected for each patient: age, sex, presenting symptom(s), history of previous surgery and findings of the clinical intraoral, neck, and cranial nerves examination.

CT and MRI of the PPS before and after contrast administration were done for all patients. Data regarding the exact site, size, extension, and vascularity of the swelling and its relation to the big vessels were determined.

CT guided fine needle aspiration cytology (FNAC) was performed in two patients only. Angiography was done in six patients who were suspected to have a vascular lesion, based on both clinical and imaging criteria. The radiologist used transfemoral approach in these six patients for selective catheterization of the carotid and vertebral arteries; performing four vessels angiography, followed by cross-compression test to assess the patency of the circle of Willis. Particulate embolization of the tumor feeders' branches from the external carotid artery was performed in five patients (proved to have glomus tumors). All embolizations were done 2–3 days before surgery.

Full laboratory investigations were done for all patients including 24 h urinary vanillyl mandelic acid in patients suspected to have paragangliomas.

Surgical technique: Preliminary tracheostomy was performed in two patients. A curvilinear skin incision beginning at the mastoid tip was used in all cases. The incision extends two fingers breadth below the lower border of the mandible, to the submental area and curved at the mid line to a lip splitting incision. The flap was elevated deep to the submandibular gland capsule to avoid injury of the marginal mandibular branch of the facial nerve. Submandibular sialadenectomy was carried out. All nerves and vessels were identified first. The posterior belly of the digastric muscle was cut and retracted anteriorly. Dissection was continued till the cervical part of the tumor was identified aided by sharply incising the stylomandibular ligament. The mandibular gingiva was sharply incised at the mid line and elevated in a subperiosteal fashion on both sides. A symphyseal (median) mandibulotomy was performed using the reciprocating saw in a straight fashion taking care not to injure the dental roots. A paralingual mucosal incision was done on the side of the tumor and extends to the anterior tonsillar pillar and the soft palate as desired taking care not to injure the lingual nerve. The muscles of the mouth floor were sharply cut and the mandible was swung laterally thus obtaining the widest exposure of the PPS (Fig. 1a). Superficial parotidectomy was done in two patients in whom the tumor originated from the deep lobe of the parotid gland with the facial nerve branches, elevated and protected during tumor excision (Fig. 1b). The paralingual incision was closed using an absorbable suture material. A maxillomandibular fixation was done with the teeth in normal occlusion using four pairs of stainless steel Ivey loops (two on each side). Two titanium miniplates and self-tabbing monocortical titanium miniscrews were used to fix the mandibulotomy (Fig. 2). The incision was closed in layers after haemostasis, and suturing the lip splitting incision in a meticulous cosmetic manner, with insertion of a suction drain.

Patients were kept on parentral fluid therapy in the first postoperative 24 h and started oral feeding in the second postoperative day. When tracheostomy was done, it was removed 3 days postoperatively. Ivey loops were removed after 2 weeks. The patients were followed up monthly in the first postoperative year and on demand for a period that ranged from 1 to 8 years.

3. Results

The commonest presenting symptom in all patients was a painless gradually progressive upper neck swelling of a variable

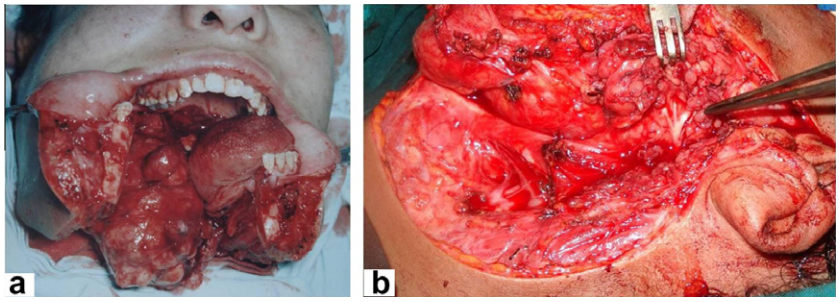

Figure 1 Operative photographs showing (a) exposure of a huge pleomorphic adenoma; (b) exposure of the facial nerve and its distal branches.

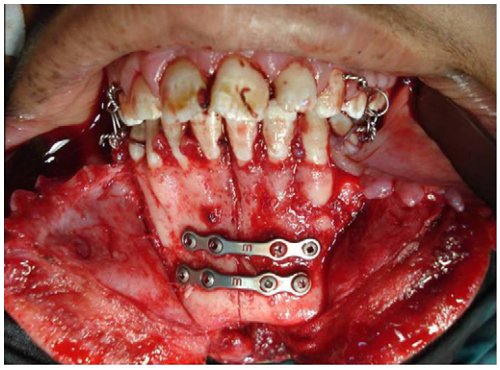

Figure 2 Operative photograph showing osteosynthesis of the mandibulotomy by miniplates and intermaxillary fixation by Ivey loops.

duration that ranged from 9 to 30 months (Table 1). None of the patients suffered from cranial nerves affection or functioning paragangliomas. Previous excision of the tumor was reported in three patients. A transoral approach was used in one of them (pleomorphic adenoma) and transcervical approach in two (pleomorphic adenoma and high grade mucoepidermoid carcinoma). Clinical examination showed a non-tender smooth non-pulsating firm swelling in the submandibular region reaching the retromandibular area of variable size (3–5 × 6–8 cm) in five patients. It extended to the parotid region in two of them. In another five patients the swelling was pulsating, with a size ranging from 3–5 × 5–6 cm, with inability to define its upper border that merged under the mandibular angle (proved to be carotid body tumor in four patients and an internal carotid artery aneurysm in a single patient). In the remaining patient there was a palpable ill defined retromandibular swelling.

The oral and pharyngeal examination showed smooth bulge of the lateral pharyngeal wall in all patients that extended to the soft palate in five of them. The upper limit of the swelling was not identifiable in three patients with the postnasal mirror while the lower limit was seen at the level of the vallecula with the laryngeal mirror. Examination of the cranial nerves and lymph nodes did not show neuropathies or significantly palpable nodes.

CT scanning showed a well defined, heterogeneously enhanced parapharyngeal swelling, 6–7 × 7–10 cm in diameter, medial to the mandible posterior to the pterygoid plates with variable extension to skull base displacing the vascular bundle posteriorly in five patients that were proved pathologically to be salivary in origin (Fig. 3a). In another five patients, proved to be paraganglioma pathologically, CT scan revealed a markedly enhanced swelling in the carotid space (Fig. 3b). The aneurysm of the internal carotid artery was shown to contain a thrombus.

MRI revealed a parotid gland tumor originating from the deep lobe in two patients by absent fat plane between it and the tumor (Fig. 4a). In patients with paragangliomas, it demonstrated intermediate signal intensity in T1 and T2 weighted images with a characteristic signal void areas indicating high velocity blood flow (Fig. 4b).

The internal and external carotid arteries were separated by the mass in cases of carotid body tumors and both were displaced anteromedially by the glomus vagal tumor (Fig. 4b).

Table 1 Patients' demographic data, presenting symptoms, and pathologic diagnosis.

No.	Sex	Age (years)	Presenting symptoms			Pathologic diagnosis
			Swelling	Dysphagia	Others	
1	Male	44	Neck/pharyngeal	Yes	Voice	Rec. pleomorphic adenoma
2	Male	35	Neck	No		Carotid body tumor
3	Female	40	Neck	No		Carotid body tumor
4	Female	20	Neck/pharyngeal	Yes	Voice	Rec. pleomorphic adenoma
5	Female	45	Neck	No		Carotid body tumor
6	Male	37	Neck	No		Carotid body tumor
7	Female	54	Neck	No		Carotid aneurysm
8	Male	50	Pharyngeal	No	Voice	Vagal paraganglioma
9	Female	35	Neck/pharyngeal	Yes	Voice/dyspnea	Rec. high grade mucoepidermoid ca
10	Male	43	Neck/pharyngeal	Yes	Voice	Pleomorphic adenoma
11	Male	22	Neck/pharyngeal	Yes	Voice/dyspnea	Low grade mucoepidermoid ca

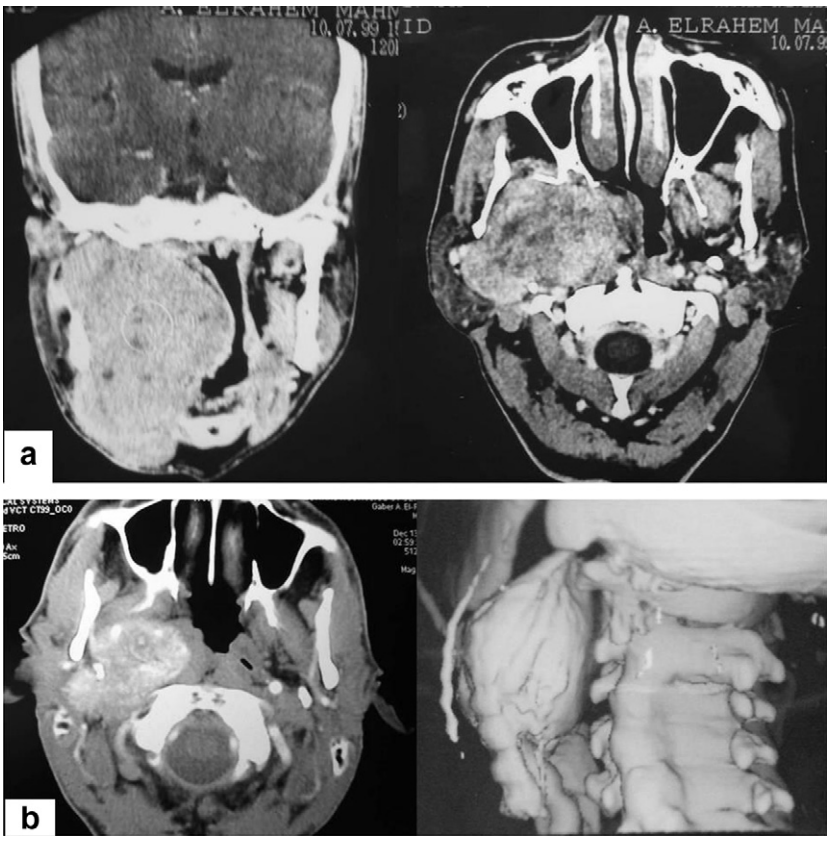

Figure 3 CT scans of patients with: (a) pleomorphic adenoma; (b) carotid body tumor.

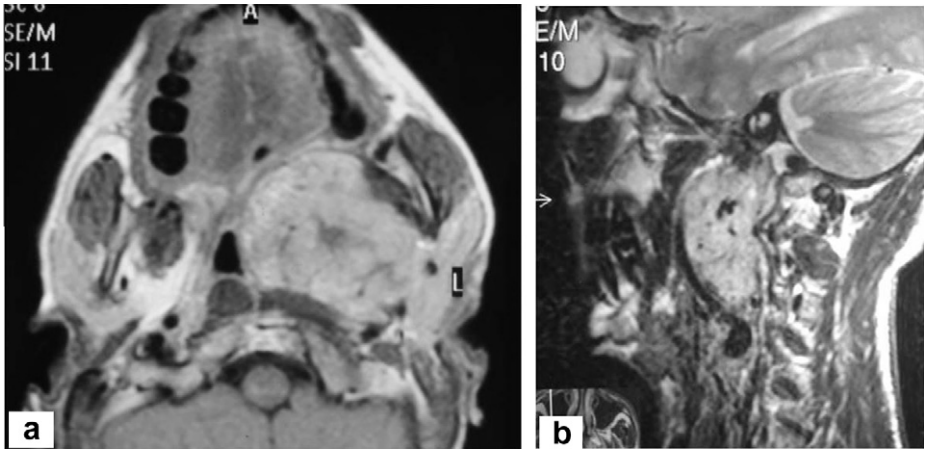

Figure 4 MRI of the patients with: (a) pleomorphic adenoma arising from the deep lobe of the parotid gland; (b) vagal paraganglioma of the superior aspect of the PPS with anterior displacement of the internal carotid artery.

The site of the paraganglioma according to the CT and MRI was variable, ascending medial to the mandible in the patients with carotid body tumor (Fig. 3b). In the patient with glomus vagale, the mass had no cervical portion (Fig. 4b). The length of the distal segment of the internal carotid artery in the patients with paraganglioma and carotid aneurysm, as demonstrated by its signal void, from the tumor to its entrance into the skull was more than 1 cm.

On carotid angiography, all carotid body tumors showed the dense roughly rounded tumor stain with goblet displacement of the internal and external carotids (Fig. 5). The glomus vagale appeared as a fusiform tumor blush displacing both carotids anteromedially. Total embolization, defined as disappearance of the tumor blush was obtained in three patients (Fig. 5b). However, in the remaining two patients, embolization was subtotal because of the presence of anastomosis between the branches of external carotid and those of the internal carotid and vertebral arteries making completion of the embolization quite risky.

CT guided FNAC was done in two patients and revealed a benign salivary gland tumor in a patient and a mucoepidermoid carcinoma in another (Table 1).

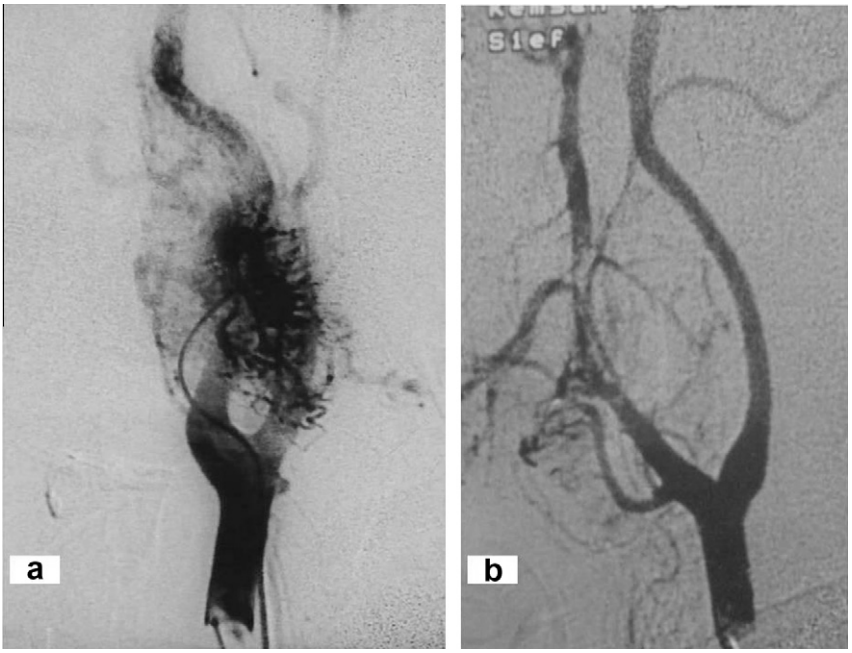

Figure 5 Carotid angiography of a patient with carotid body tumor: (a) before embolization; (b) after embolization.

The 24 h urinary vanillyl mandelic acid levels were normal. Operatively, in patients with salivary gland tumors, the transmandibular approach allowed complete, safe excision of the whole tumor without breach of the capsule. Moreover the wide exposure obtained by such approach enabled adequate intact resection of the salivary and highly vascular lesions with visualization and protection of the important neurovascular structures. Replacement of the internal carotid artery with saphenous vein interposition graft was done in two patients, one after excision of a carotid body tumor because of inability to safely dissect the artery due to massive adhesions and the other with carotid aneurysm, after obtaining proximal and distal control. The transcranial Doppler was used for monitoring the cerebral circulation during carotid cross-clamping so, carotid shunting was not needed.

Patients were able to start fluid diet in the second postoperative day, soft diet after removal of the intermaxillary fixation, and unrestricted diet at 1 month.

Infection of the miniplates was reported in one patient during the first year of follow up. Plates were removed without further consequences. Cranial neuropathies were reported in three patients who had paraganglioma in the form of combination of IX–XII cranial nerve affection in two patients and affection of the hypoglossal nerve only in another patient leading to variable degrees of palatal pharyngeal laryngeal and lingual pareses. Although dysarthria was not marked and nasal regurgitation was not reported, these patients suffered from dysphonia, chocking, and open nasality. They reported gradual adaptation to the dysphagia that no longer presented a problem. One of these patients was subjected to medialization thyroplasty (Ishiki type I) using high density porous polyethylene after 18 months.

Dental losses, malocclusion, plate exposure, lower lip sensory deficit and temporomandibular joint troubles as pain, trismus, clicking and dislocation were not reported by any patient. All the patients were satisfied by esthetically accepted facial scar that got fainter with the lapse of time. Recurrence was not reported during the period of follow up. The patient with the internal carotid artery aneurysm died 72 h after the operation due to cerebrovascular stroke.

4. Discussion

Parapharyngeal tumors are rare, accounting for 0.5% of all head and neck neoplasms.[6–8] They can originate from any of the structures normally present in its compartments. Salivary followed by neurogenic tumors account for the most common neoplasms reported among literature.[9–12] Reports indicate that 80% of them are benign.[13,14] The most frequent neoplasm of salivary gland origin is pleomorphic adenoma arising de novo or more commonly from the deep lobe of the parotid gland and extend through the stylomandibular tunnel into the PPS.[10,12] A careful preoperative workup in the form of imaging and cytology is highly recommended by many authors in planning successful surgical treatment with a safe approach, minimal functional and cosmetic hazards and without recurrence.[9,15] In the present study, the radiologic armamentarium in the form of CT, MRI, and angiography presented the corner stone not only in the overall assessment of 11 patients with PPS occupying lesions, but in planning and selecting the transmandibular approach to manage these patients. It helped to determine the size and extent of the lesion, to assess the degree of vascularity, to delineate its relationship to the internal carotid artery and skull base, to predict its origin and to define its intracranial involvement as stated by many authors.[9,16] Angiography is recommended in the workup of all enhancing and vascular lesions particularly if paraganglioma is suspected and embolization is considered.[9] It is also indicated when involvement of the carotid artery is suspected and to exclude secondary lesions.[8,17]

Under most circumstances, a presumptive diagnosis can be made on the basis of the imaging studies. Although

preoperative knowledge of the tumor pathology is mandatory for treatment planning it presents one of the dilemmas in managing PPS tumors. The predictive diagnostic value of FNAC in PPS tumors was found to be 75%. Final diagnosis was ascertained only after complete excision.[12] It should be performed guided by and following diagnostic imaging to exclude vascular lesion and avoid injury of vital structures.[4,7,10,15]

The surgical approaches to the parapharyngeal space include: transoral, transcervical, transparotid, transmandibular, and infratemporal.[5] The choice of approach is to obtain adequate tumor visualization to ensure complete tumor removal with preservation of the surrounding nerves and vessels and to control any hemorrhage.[16,17] Papadogeorgakis et al. (2010) considered five points to be the main parameters in selecting the best approach in treating tumors of the PPS: the proximity and the projection of the tumor to the oropharyngeal wall or the neck, the size of the tumor, the suspicion of malignancy, the vascularity, and relation of the tumor to the neck neurovascular bundle.[10] Although the transoral approach is a cosmetic approach and offers a direct access to the parapharyngeal space, it gives a limited exposure to the PPS with consequent unsatisfactory control of neck great vessels, making it difficult in controlling massive hemorrhage, and increased incidence of nerve damage and capsular rupture leading to tumor recurrence.[9,10] Nowadays this approach is reserved for well defined, avascular tumors less than 3 cm, projecting in the oropharynx, and very near to the mucosa.[6,9,10,18] The commonest approaches used among literature reporting big series of PPS tumors are the transcervical and the transparotid.[11,14,17] Although preferred by many authors to achieve safe complete excision of most PPS tumors including those arising from the deep lobe of the parotid gland, such approaches may not give an adequate exposure in certain cases. The main exposure difficulty that hampers resection attempts of PPS tumors is the mandible. Attempts to anteriorly sublux the mandible give limited improvement and carries the risk of permanent damage of the temporomandibular joint.[19] Although there is a wide agreement that the widest exposure of the PPS is obtained by mandibulotomy, its rate is reported among several published series between 2% and 10%.[12] Most publications cite the size, vascularity, malignancy, invasion of skull base, recurrence, and site being confined to the superior aspect of the PPS as the criteria for selecting this approach.[4,9,10,12,19] As regarding the size, some authors use terms of big, extremely large, or giant, others, being more decisive, recommend performing mandibulotomy for tumors more than 4–5 cm.[9,19,20] In the present study the transmandibular approach was selected based on the following criteria: first, the size of the three solid benign tumors that ranged from 6 to 10 cm in their dimensions. Second, is the presence of malignancy with recurrence. We had three cases with recurrence in our series. Third is the high vascularity detected by imaging modalities. Carotid angiography was beneficial not only in diagnosis but also in limiting blood loss markedly during tumor resection by performing selective embolization. In such patients, the transmandibular approach was of value to allow the vascular surgeon to do comfortable easy and adequate exposure and vascular control of the distal segment of the internal carotid artery during excision of paragangliomas and carotid aneurysm. A big advantage of the transmandibular approach in excision of paragangliomas is that it allowed the direct access to and exposure of the medially and anteriorly displaced internal carotid artery.[21] Moreover, the wide exposure of the superior part of the PPS facilitated performing the distal anastomosis during saphenous vein grafting that was done in two patients even when near the skull base. The identification of a distal segment of internal carotid artery below the skull base not less than 1 cm by the MRI is an essential prerequisite to surgical interference demanded by the vascular surgeon to allow vascular control or perform a probable anastomosis.

Various locations have been reported for mandibulotomy to widen the access into the PPS. In this study, the median mandibulotomy with lip splitting, usually termed mandibular swing, was preferred as it allowed the widest exposure of the PPS, saving the inferior alveolar bundle thus preserving inferior lip sensation and dental viability. In order to avoid lip splitting and intraoral incision of the mandibular swing approach, a new technique of subcutaneous mandibulotomy was used.[20] The temporomandibular joint function was not found to be affected in our patients as care was taken during surgery not to use too much force during lateral swing of the mandible. Tracheostomy was performed to avoid anticipated airway problems only in the beginning of this study in two patients and not done thereafter without reported postoperative airway problems. Apart from the plate infection reported in this study in a single patient, complications in the form of cranial neuropathies (in three patients) were primarily related to vagal paraganglioma and carotid body tumor excision rather than being related to the mandibulotomy approach. It is emphasized that since excision of these tumors is followed by such problems, rehabilitation of cranial nerve deficits presents an integral part of their management.[21] Following this principle, medialization thyroplasty was done to improve the troublesome laryngeal incompetence that persisted in a single patient after excision of the vagal paraganglioma.

In conclusion, based on a preoperative radiologic and cytological workup, the transmandibular approach is better selected to excise the vascular lesions of the PPS. This is specially recommended, when lesions occupy its superior aspect or when vascular control of the distal segment of the carotid artery is not achieved through the cervical route. It is also preferred in solid benign or malignant tumors more than 5 cm especially if recurrent.

MRI is the best radiologic modality in the preoperative assessment of these tumors.

During surgery for PPS mass, the surgeon must be ready to modify his plan and perform mandibulotomy if complete safe excision seems difficult.

A team work consisting of the head and neck and vascular surgeons and the radiologist is essential in obtaining the best results of managing vascular PPS lesions.

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